SECTION 2.14 CONSTRUCTION METHODOLOGY
(WAC 463-42-255)

This section describes the procedures that will be used for construction activities within watercourses, wetlands, and other sensitive areas.

2.14.1 INTRODUCTION

The pipeline will cross many areas requiring specialized construction approaches, including approximately 78 wetlands and approximately 293 watercourses. The watercourses include 8 river crossings, 224 stream crossings, and 61 crossings of irrigation canals. The pipeline route minimizes crossing and disturbance of wetland and watercourse ecosystems, and other sensitive areas to the maximum extent possible. Final construction procedures will contain restrictions for setbacks, temporary equipment bridges, spoil placement, alignment modifications, grubbing limits, and restoration techniques.

Several methods for crossing sensitive areas will be employed. Most river and stream crossings will be accomplished by diversion and trenching methods such as stream diversion and trenching, flume diversion and trenching and channel isolation and trenching. One crossing is proposed to utilize horizontal directional drilling and twelve waterway crossings will use existing bridges. Unlined irrigation canals will be crossed by open cut methods, and concrete canals will be crossed using jack and bore techniques where feasible.

The following general construction guidelines will apply to smaller streams:

- Construction will be performed during periods of lowest sensitivity,
- Trenching will be done perpendicular to the stream,
- The construction time and clearing of riparian vegetation will be minimized,
- Standard erosion and sediment control measures will be used, and spill prevention best management practices will be followed during construction,
- Blasting around and within streams will be limited as much as possible,
- Debris accidentally introduced into streams will be promptly removed,
- All other appropriate Best Management Practices will be followed, and
- Streambanks, vegetation, and streambeds will be restored immediately after construction. (Bank restoration is particularly important in shallowly incised streams with low banks, to prevent channel migration).

Protection of sensitive areas will focus on erosion and sediment control measures in or near wetland areas and other watercourses. A variety of control measures will be used to reduce erosion and sedimentation during construction, and these are described in Section 2.10 Surface Water Runoff. These measures include both limiting certain construction activities and installing temporary control structures such as sediment traps and filter fences. Control measures will be further detailed in a Stormwater Pollution Prevention Plan for Construction. Specific sizing and locations of control measures will be included in the final design.

2.14.2 EQUIPMENT ACCESS AT SENSITIVE AREA CROSSINGS

Construction of the pipeline will require the crossing of small irrigation ditches, irrigation canals, small or moderate-size streams, and six river crossings (two crossings each of the Snoqualmie River and South Fork Snoqualmie River, plus the Yakima and Columbia Rivers). There are approximately 293 watercourse crossings along the proposed route. In addition to pipeline construction across these watercourses, the installation process will require periodic equipment crossings.

Temporary access along the construction right-of-way will require the installation of either culverts or beam bridges. Equipment will be moved along existing roadways and bridges to work both sides of larger watercourses that are not feasible to span.

Construction of these equipment access crossings will be coordinated with EFSEC to determine the most appropriate methods and any timing restrictions. Equipment access crossings will consist of simple bridges constructed of timbers, pipes, or steel beams with a decking made of mats, planks, or metal. For crossings with intermittent flows, logs from right-of-way clearing or timbers up to 12" square could be placed in the stream with sufficient spacing to allow water flow. Matting could then be laid across these supports. Approaches to the bridge or crossing area will be spanned or matted, depending on the nature of the approach. This will protect the riparian zone adjacent to the water course. Equipment will not be allowed to drive through streams. Erosion and sediment prevention devices will be installed downstream of all temporary crossings. Figure 2.14-1 shows typical equipment access crossings at streams.

FIGURE 2.14-1 - TYPICAL CREEK AND EQUIPMENT CROSSING

Total time of construction through a particular area, including clearing and site preparation to cleanup and restoration may last approximately 4 to 5 weeks, but the actual stream crossing could take 48 hours or less. The equipment crossings will remain in place during this period or as required to allow equipment access to the area without disturbing the waterway.

2.14.3 STREAM AND RIVER CROSSINGS

2.14.3.1 Crossing Methods

Stream and river pipeline crossings, as well as canal and wetland crossings, will be accomplished using the following methods:

- C Flume and Trench
- C Divert and Trench
- C Dry Trench
- C Wet Trench
- C Crossing Below a Culvert
- C Existing Fill Crossing Above a Culvert
- C Horizontal Directional Drilling
- C Jack and Bore
- C Bridge Crossing

In general, wet trenching will be used for streams with low flows; diversional trenching will be used on larger streams.

Typically, open trenching methods are used to bury the pipeline into the bed of a watercourse. Open trenches will be confined to the established right of way with no additional clearing required. Crossings only take a few days or less to finish and sedimentation impacts will be brief. Variations to this method, such as Flume and Trench, Divert and Trench, and Dry or Wet Trench, are used in particular situations to ensure protection of the aquatic resources. Opportunities to cross streams on bridges or in existing roads are used wherever feasible, and horizontal directional drilling is proposed for certain situations. Boring is used to cross under roads and canals. Each method is discussed below. The proposed crossing method for each stream is given in Table 3.4-8 in Section 3.4.4 Fisheries.

The trench will generally be deeper than the normal 5-foot depth in order to place the pipe deeper than the calculated maximum scour depth. The trench sidewall slopes generally will be one horizontal to one vertical (1:1), but may be modified based on a geotechnical analysis during final design.

Pipeline construction techniques for water crossings assume at least standard burial depths of 4 to 5' to avoid exposure from scour. Where high velocities are indicated along erodible bed materials, additional geotechnical investigations for scour depth have been or will be conducted and the pipe will be buried deeper according to the findings. Unstable or eroding banks at the crossing locations will also require geotechnical investigation prior to design and construction. The crossing method to be used at each sensitive area crossed by the pipeline will be determined using the information available, including field observations, but the methods will be verified or refined during the alignment and engineering design studies.

The pipe at each major crossing will be hydrostatically tested. The pipe string will be tested before it is placed in the trench and backfilled and again tested as part of segment crossing after it is in place. Many will also be tested again as part of larger segments of pipeline that are tested when complete. The hydrostatic test is done by sealing the end of the pipe section, filling it with water, and applying pressure at 125 percent of the maximum operational pressure, and holding it for 4 hours (if the pipe has already been buried, the test pressure is held for 8 hours). The test water will normally be pumped out and reused. When it is disposed, it will be filtered before discharge to a water body.

The pipe will be bedded in soft material (at least material lacking sharp rocks that could damage the coating). The bedding material is the bottom six inches in the trench (below the pipe) and covers the pipe a foot deep before other backfill is placed on it. This material is normally prepared in place by a "padding" machine that crushes the rocks in the sidecast trench spoils and feeds it into the trench. In cases where the native material is not suited to the process, the bedding material such as sand will be hauled in from elsewhere. Some of the larger rocks will be sorted out from the backfill and hauled away.

In all cases, shoreline areas will be returned to their original contour, mulched, and reseeded or revegetated with appropriate vegetation as soon as possible after construction is complete (normally within six months). Cleared material will not be placed in the water body, thus avoiding impacts to fish movements. Site-specific erosion control plans will be developed and implemented for each stream crossing using methods described in Section 2.10 Surface Water Runoff.

Flume and Trench

The flume and trench method is proposed for crossings ranging in size from small watercourses through moderately sized streams. The first step will be to construct the temporary dams and flume. This will be largely a hand operation assisted by a loader or backhoe from the shore. The main flow path of the stream will be routed around the portion of the stream to be crossed using a flume or pipe bypass. Adjacent to the crossing, the stream will be sandbagged both upstream and downstream, forming dams across this area of the stream, thus directing the stream flow through the bypass pipe (see Figure 2.14-1). The water flow will be maintained through the bypass during construction. Water contained within the dams will be pumped onto the ground away from the stream to allow it to percolate into the ground or flow back toward the stream through filtering media such as filter fences and straw bales. This method is effective for preventing excess sediment from increasing the turbidity of the water in the stream.

The next step will be digging the trench. This will normally be done with a trackhoe working from each side of the stream. Temporary bridges or nearby road bridges will be used to get equipment from one side to the other. The crossing preparation area will typically be 60' by 100' on both sides of the stream crossing. The work area through the stream will be reduced to 30' wide or less. Before trench excavation begins, vegetation and topsoil in the riparian zone will be removed and stockpiled for later use. Material removed for trench construction will be stockpiled on the ground outside the sensitive area and contained within an earthen berm. Once the trench has been excavated, preconstructed lengths of pipe will be pulled through the stream ditch underneath the bypass pipe. Concrete coated pipe will be installed under the stream course and extended a nominal 10 feet each side of the ordinary high water mark to prevent the pipe from floating up through the surface after water is returned to the streambed and to provide an extra measure of protection for the pipe in case of unexpected flood scour. (Figure 2.13-2 Typical Stream Crossing)

Figure 2.14-2 Typical Stream Crossing

When the above work is completed,the streambed will be re-contoured to its original form and clean gravels of a size similar to the original stream will be replaced into the top of the trench backfill in the streambed. Water will then be pumped into the prepared stream crossing to equalize hydrostatic pressure. The sandbags and the bypass pipe will be then be removed from the streambed. The trench on both sides of the stream will be backfilled and topsoil returned to the original locations. If necessary, the banks will be stabilized with jute matting or stone rip-rap to prevent erosion. Erosion and sediment control devices installed downstream of the crossing will be left in place until the temporary equipment access bridge (where one is used) is removed from the stream during the cleanup portion of the work. (Figure 2.14-3 Typical Stream Restoration)

Figure 2.14-3 Typical Stream Restoration

Divert and Trench

The divert-and-trench method will be used on larger stream crossings where the depth is shallow and the bottom is stable or on streams with two or more channels at the crossing location. Approaches to the stream will be prepared the same as for the flume-and-trench method described above. Since the flow of larger streams is too great to be handled by a flume pipe, water will be diverted away from the construction area. Precast highway barriers or specialized diversion barriers will be used to divert the flow (with sand bags and plastic as needed), installed by crane upstream of the crossing and extending a little more than halfway across the water crossing. The diversion barrier will angle downstream past the trench area and back to shore, forming a protected area that will be pumped dry (see Figure 2.14-4).

Figure 2.14-4 Diversion Method for Stream Crossing

Fish will be trapped and relocated to the flowing stream. Water will be pumped from behind the diversion dam onto land where it will be allowed to go through filter fabric and straw bales and flow back to the stream. The trench will then be dug with a trackhoe and the pipe installed with a cap on the end. The trench will be backfilled and the surface restoration completed with the backhoe or other equipment. At that time, water will be pumped in and/or the barrier dam will be removed at a controlled rate and moved to the other side of the stream. The remaining trench will then be dug, the pipe installed and connected to the previously installed piece. This part of the trench will stay open long enough to coat the connection with quick-setting concrete before it is backfilled, the surface prepared with stream gravel, and the barrier dam removed. This exercise will take only a few hours for a typical stream.

In the case of a two-channeled crossing, a temporary diversion dam would completely block one channel, diverting all the flow to the other while the trench is dug in the dry. After the pipe is in place and the channel restored at the first channel, then the water would be diverted from the second channel while work is completed there.

Dry Trench

The dry trench method is proposed for watercourses where the stream is dry at the time of construction. The construction methods will be the same as cross-country sections of the pipe except for two things. Provision will be made for handling water coming down the channel if a rainstorm occurs during construction (such as a flume). Also, when the construction is complete, the surface will be armored similar to the adjacent streambed to prevent scour during high-flow events.

Wet Trench

The wet trench method is proposed for watercourses where the use of diversion barriers are not necessary due to very low flow velocity and volume or stream bank conditions. An area with relatively slow current will be chosen for the crossing. Because the flow velocity is low, sediments disturbed during construction phase are expected to settle quickly and not result in a problem downstream.

The trench will be dug with a dragline bucket or large backhoe. Except for the bucket, no other equipment will be allowed to work in the water. The excavated material will be placed in holding areas outside the riparian area on both sides of the river. Filtering media will be used to clean the water which will then be allowed to flow out of the holding area and eventually return to the stream. Preconstructed segments of pipe will be pulled into the prepared trench by equipment on shore. If the mainline has been installed up to this point, the crossing line will be welded into the mainline. If the mainline pipe has not already been installed, the ends will be left with temporary caps installed approximately 20' away from the river bank to prevent water from entering the pipe. This will allow the trench to be backfilled so the pipe crossing the stream can be tied into the mainline pipe at a later time.

After pipe burial depth is verified, the stockpiled materials will be placed back into the trench and the surface armored with gravel. The banks will be returned to their original contour and stabilized and riparian zones will be replanted in the disturbed area over the trench.

Crossings in Existing Fill Below Culverts

A few streams will be crossed in existing road fill, but the culverts are too shallow to obtain the desired depth of cover above the culvert. In some cases, the culverts need replacing anyway because they are damaged or not adequate. At these crossings, the equipment will work in the existing road bed, but the culvert will be removed while the pipeline is installed and backfilled. Water flow will generally be handled by flume after the culvert is removed. Other erosion and sediment control measures will be as in other crossing methods. The culvert will be replaced at the original end elevations. In cases where the culverts do not need to be replaced, the pipeline will be installed without culvert removal.

Crossings in Existing Fill Above Culverts

A few of the stream crossings will be in existing fill (placed for roads or railroads) above culverts. In these cases the fill above the culverts is deep enough that the culvert will be undisturbed by the placement of the pipeline. About 50 to 250 feet of trench (depending on how restricted the width is) would be excavated by trackhoe. The pipe string of 2 to 5 sections would be welded, radiographed, and coated on skids or blocks. The pipe string will then be moved into place by the trackhoe and side-boom tractor and lowered into the trench. After it is welded to the previously laid piece, coated, and inspected, then the backfill is placed in the trench.

Construction will be the same as in roadbeds except that filter fabric or other means will be used to prevent excavated material from inadvertently falling in the stream.

Horizontal Directional Drilling

Horizontal directional drilling is proposed for crossing the Columbia River, and is an alternate method for the Snoqualmie River if the bridge crossing becomes unavailable as discussed below. Directionally drilled crossings will be installed by drilling and reaming a pilot hole in a long catenary curve below the bed of the watercourse from a set-back position on the bank to a set-back location on the other bank (see Figure 2.14-5). The depth below the river bed varies, but is normally 10' or greater. Figure 2.14-65 shows the required depth by DOT regulations, a minimum cover of 48 inches in materials other than solid rock and 18 inches in solid rock for conventional trenching and blasting. For this project, a minimum of nominally 10' of cover will be used. A pilot hole will be drilled and then reamed with reamers of increasingly large diameter in order to prepare the hole for the pipe. After the reamed hole is prepared, the pipeline will be pulled through. Drilled crossings will require a minimum area of 100' by 250' on the drill side and 175' by 100' on the opposite side. A large cleared staging area on the drill side is needed for the drilling equipment, support equipment, and a sump for drilling muds. On the opposite side, the cleared area is needed to fabricate and test the section of pipe which will be pulled under the river. Sump areas are required to contain the drilling fluids used during the drilling process and to capture the fluid once the initial hole is completed.

Figure 2.14-5 Columbia River Horizontal Directionally Drilled Crossing

The drilling fluid is normally a bentonite mud mixture which is used to flow cuttings from the drill bit back to the drill rig. It also lubricates the hole during drilling and maintains positive pressure in the hole so the hole does not collapse before the pipe is installed. Horizontal directional drilling has several advantages over alternative crossing methods. Work areas are set back from the river and banks are not disturbed. Normally, the streambed is not disturbed and the pipe is placed 10' or more below the streambed.

Not all stream crossings are candidates for bores or drills. A significant amount of staging area is required on both sides of the stream to successfully compete bores. Even more is required to complete Horizontal Directional Drills (HDD). If the slope to the stream side is steep, wooded, or unstable, it is not possible to establish the staging area and mobilize the equipment to complete the hole. Also, sub-surface geology may be such that a drilled or bored hole would collapse before the hole was completed or the pipe could be pulled through. Finally, the impacts to the upland areas caused by the drilling equipment, the possibility of the drilling mud fracturing out, and vehicular traffic required in the drilling operations may far outweigh the impacts to the stream by using a trenching technique.

Directional drilling works best in relatively soft, consolidated materials such as dense clay or sandstone. These materials are conducive to drilling and have the mechanical integrity for the hole to remain open. In unconsolidated soils, such as glacial till, and where cobbles and boulders are present, directional drilling may not be practical because the hole cannot be maintained to pull the pipe through. In very hard rock, such as basalt, drilling is extremely difficult and time consuming. Fractures are often present in such hard rock and this leads to the drilling mud migrating out of the hole and potentially reaching the streambed. Additional geotechnical studies have been completed to confirm suitable conditions at the Columbia River.

Jack-and-Bore

The Jack-and-Bore technique is only proposed for canal crossings. The first step after ROW clearing is to dig a bore pit on one side and a receive pit on the other. These have to be about two feet deeper than the depth of the pipe. The bore pit will be about 10 to 15 feet wide at the bottom of the pit, and possibly wider at the top, depending upon the soil and slope conditions, and 50 feet long. The receive pit will not need to be larger than 10 by 10 feet at the bottom of the pit. The next step is to lower the boring equipment into the launch pit along with the first joint of pipe. The boring machine augers a hole and at the same time pushes the pipe through it, one length at a time. The pipe lengths will have the corrosion coating and a one-inch thick concrete jacket already in place before being installed.

In order to reach a depth of at least 4 feet below the bottom of the canal, the pits could each be up to 12 feet deep or deeper, depending upon the canal depth. The maximum crossing distance that is feasible with the jack-and-bore method is approximately 300 feet. Jack-and-bore is not feasible in bedrock nor in large boulders.

Crossings on Bridges

Twelve of the water crossings currently are spanned by bridges. Where possible, the pipeline will be placed on these structures. The pipes would have an external concrete coating and will be placed on supports attached to the bridge structure. Impacts to the stream habitat and fisheries resources at these locations will be avoided because construction pits or pads would not be created. Very little riparian habitat would be removed and no in-channel work would occur. Bridge crossings are not expected to adversely affect sensitive areas.

2.14.3.2 Major Rivers and Other Unique Crossing Conditions

Sensitive areas or areas where sensitive construction constraints exist along the pipeline alignment include wetlands and watercourse crossings (rivers, streams, and canals). Selection of construction techniques will depend on habitat conditions, concerns for reducing potential channel disturbance and downstream sedimentation, and feasibility of applying open cut methods. Watercourse crossing that require special construction techniques due to physical site conditions are described below and are summarized in Table 2.14-1. The remaining sensitive areas do not require special crossing techniques.

Snoqualmie River Crossing No. 11 - North of Woodinville (MP 8.2)

The river at this crossing is slow-flowing in an alluvial valley bounded by steep upland banks. The depth and classification of the alluvial materials forming the river valley indicate that a horizontal directionally drilled crossing is feasible.

(1) Crossing Geometry

- Bank to Bank Width = 200'
- Bank Height = 15'
- Depth = 6 to 8'

(2) Construction Method

Two construction methods are being considered. The preferred crossing methodology will be to place the pipeline within the utilidor constructed as part of the new Snohomish County-owned bridge across the Snoqualmie River. This alternative would be selected unless there was no longer room for the pipeline within the utilidor at the time of pipeline construction.

Preferred Method

- C Placement of the pipeline within the Snoqualmie River Bridge utilidor

Alternative Crossing Method

- C Horizontal Directional Drill
- C Length = 1,600'
- C Coat pipe with Fusion Bonded Epoxy (FBE) and abrasion coating

(3) Construction Scope

- C Drilling Operations (assume alluvial materials)
- C Pipe assembly, test and pullback support
- C Install pipe from MP 8.1 through MP 8.4
- C Open cut paved road and backfill with lean concrete

Tolt River (MP 24.0)

The Tolt River is a fast-flowing stream bounded by alluvial banks with a gravel and rock bed. The topography would preclude the use of a horizontal directionally drilled crossing. Based on the following, an open cut crossing can be rapidly installed during low flow conditions with minimal impact.

(1) Crossing Geometry

- C Channel Width = 40' (Main Channel) and 30' (Secondary Channel)
- C Island Width = 400'
- C Bank Height = 6' (Riprap along the north bank)
- C Depth = 1 to 2'
- C Paved Road is next to north bank

(2) Construction Method

- C Trenching using Portadams to divert flow
- C Length is 1,000' of 14" pipe with 1" concrete coating
- C Open cut road along north bank and backfill with lean concrete
- C Assemble, pretest, and install pipe, and hydrostatically test in place.

(3) Construction Scope

- C Trench, install, and backfill of river and road crossing.
- C Restore roadway and bank protection on north side

Snoqualmie River Crossing No. 38 (MP 34.1)

The Snoqualmie River at this location is relatively slow flowing in an alluvial valley with a cutoff slough and wetlands along the west and south banks. The crossing is located at an abandoned railroad easement with an elevated embankment. A metal trestle bridge over the river and numerous timber bridges crossing sloughs and drains make up the trail easement going south. The trestle span over a two lane road along the north bank has been removed. The north bank is heavily forested with heavy underbrush. The abandoned rail line is part of the King County trails system.

South of the crossing the alignment follows the railroad embankment with wetlands along both sides plus at least 3 additional timber bridges. There are at least two cultivated fields west of the embankment with a drain in between the fields and embankments. Length of this section is about 3,000'.

Key construction issues included the following concerns:

- C Maintain water quality in river
- C Minimize wetlands disturbance
- C No impact on trail use after construction
- C Minimize disruption of traffic on road along north bank
- C Use or avoid existing bridges

The initial assessment to determine crossings along this section of the pipeline included:

(1) Crossing Geometry

- C Channel Width = 120'
- C Bank Height = 10 to 20'
- C Depth = 8 to 10'
- C Paved road is next to bridge pier along the north bank

(2) Construction Method

- C Trench road along north bank and backfill with lean concrete
- C Install the pipe as a riser to transition from road crossing to bridge crossing

- Place protective concrete structure around pipe
- Hang carrier pipe under the bridge
- Transition from bridge to buried line in trail grade with factory bends

Bridges Over Creeks and Wetlands (MP 34.2 to 36.2)

(1) Typical Crossing Geometry

- Bank to Bank Width = 30 to 150'
- Bank Height = 5 to 20'
- Depth = 1 to 5'

(2) Construction Method

- Pipe to transition from trench to bridge using factory or field bends
- Pipe to set on the caps of the bridge supports (typically timber construction), nested against the longitudinal bridge beams.
- Pipe to be concrete coated

South Fork of the Snoqualmie River Crossing No. 42 - North Bend (MP 36.2)

The river at this crossing is a fast flowing stream with a rock and gravel bed and steep banks. The banks and adjacent approaches are low and flat. Gravel bars and multiple channels are present at and downstream of the crossing point. The channel geometry and construction scope at this location are as follows:

(1) Crossing Geometry

- Bank to Bank Width = 300' (Secondary Channel); 500' (Main Channel)

(2) Construction Method

- Hang from bridge with pipe set on cap beams of bridge supports

South Fork of the Snoqualmie River Crossing No. 43 - 145th Street SE (MP 39.4)

Although only a short distance upstream of the first South Fork crossing, the topography at this site is quite different. The river is still a fast flowing stream with a gravel and rock bed. The route is along an abandoned railroad embankment where the bridge is surfaced and fitted with guard rails for pedestrian use. The railroad bridge is curved horizontally and has concrete abutments and piers with a steel superstructure and wooden deck. The approach embankments are relatively wide (20' plus).

The installation method that appears best suited for this site is a bridge crossing, based on the geometry and site conditions described below. This construction method was chosen to utilize the existing piers. The pipeline could penetrate the abutments at trench depth and be supported at the abutments and piers. The pipe would follow the horizontal curve of the bridge.

(1) Crossing Geometry

- Bank to Bank Width = 120'
- Bridge has horizontal curve along entire length
- Bridge is steel girder construction and sets on two concrete piers and two concrete abutments

(2) Construction Method

- Hang from bridge with pipe set on the concrete piers. Pipe to be field bent to match the horizontal curve of the bridge.
- Penetrations in abutments are to be drilled
- Remove then restore chain link fence
- Replace concrete decking if removal is required for construction
- Extend concrete wing walls on the west (downstream) side to protect backfill over pipeline

West Side of Snoqualmie Pass

Aerial inspection and ground reconnaissance of the western slope of Snoqualmie Pass shows the area to have limited space available for the construction of a pipeline. To reduce impacts, the existing King County Cedar Falls Trail, the State of Washington John Wayne Trail, and Tinkham Road will be utilized as much as possible. The trails are reasonably straight and the bridges are still in place. Construction throughout the west slope of Snoqualmie Pass (North Bend to the Pass) involves numerous difficult areas. These concerns were considered when the stream crossing methods were selected based on the information described below with special considerations for Humpback Creek and Olallie Creek.

(1) Crossing Geometry and Locations

- Bank to Bank Width = 10 to 50'
- Bank Height = 2 to 12'
- Depth = Dry to 2'
- Locations

MP 41.2	Boxley Creek

MP 44.9	Hall Creek
MP 46.2	Mine Creek
MP 49.9	Rock Creek
MP 50.4	Harris Creek
MP 51.9	Carter Creek
MP 52.5	Hansen Creek

(2) Construction Method

- C Crossings are primarily adjacent to roads. Pipeline will be aligned upstream of the road culvert or bridge. A small workspace will be cleared on both banks and the stream flumed.
- C Trench will be dug and backfilled with trackhoes with selective blasting done to remove rock.
- C Pipe will be coated with 1" of concrete. A 40' length will be placed at each crossing.
- C Transition to the crossing will be done with field bends.

<u>Humpback Creek (MP 55.2), Crossing #78</u>

(1) Crossing Geometry

- C Bank to Bank Width = 25'
- C Bank Height = 3'
- C Depth = 2 to 3'
- C Stream is a fast flowing and scenic stream with large boulders forming the stream bed.

(2) Construction Method

- C Modified trench will be used.
- C With a trackhoe roll large boulders off the trench line. Excavate the trench a minimum of 48" below scour depth .
- C Minimize the movement of equipment through the crossing.
- C Assemble 120' of concrete coated pipe and install as a drag section.
- C Backfill with rock and/or lean concrete. Roll large boulders over the trench line to reconstruct the natural look of the stream.

<u>Olallie Creek (MP 56), Crossing #83</u>

(1) Crossing Geometry

- C Bank to Bank Width = 13.8'

- C Bank Height = 4 to 6'
- C Depth = 1 to 2' (high velocity)

(2) Construction Method

- C A small workspace will be cleared on both banks and the stream flumed.
- C Trench will be dug and backfilled with trackhoes with selective blasting done to remove rock.
- C Pipe will be coated with 1" of concrete. A 40' length will be placed at the crossing.
- C Transition to the crossing will be done with field bends.

East Side of Snoqualmie Pass

Aerial and ground reconnaissance of the eastern slope of Snoqualmie Pass (Keechelus Lake Area) shows the area to have several narrow cuts and embankments, numerous bridges, and limited right-of-way access over much of the Iron Horse Trail segment from the Pass to near Cabin Creek. The bridge structures along this alignment tend to be relatively small. The structures can typically be matched by a pipeline bridge adjacent to the trail bridge or have the existing bridge deck upgraded to support the pipeline and potential maintenance equipment. In addition to bridges, there are numerous culverts that will be crossed. Drainage patterns created by these culverts will be restored after pipeline installation. Three crossings that require special considerations are discussed below in terms of the channel configuration and construction technique.

<u>Roaring Creek (MP 64.1), Crossing #97</u>

(1) Crossing Geometry

- C Bank to Bank = 60 to 80'
- C Channel Width = 20'
- C Bank Height = 20 to 30'
- C Depth = 2 to 3'

(2) Construction Method

- C Open cut on the downstream side of the railroad bridge
- C Clear small work spaces on each bank (approximately 40 by 40')
- C Flume the stream to divert flow
- C Trench the crossing, assemble and test the concrete coated pipe, and place in the trench.
- C Backfill the trench with the native rock and gravel, restore the banks, and place native stone as riprap on both banks.

Meadow Creek (MP 65.5), Crossing #99

(1) Crossing Geometry

- C Bank to Bank Width = 120'
- C Bank Height = 15'
- C Depth = 2 to 3'

(2) Construction Method

- C Open cut on the downstream side of the railroad bridge
- C Clear small work spaces on each bank (approximately 40 by 40')
- C Flume the stream to divert flow
- C Trench the crossing, assemble and test the concrete coated pipe, and place in the trench.
- C Backfill the trench with the native rock and gravel, restore the banks, and place native stone as riprap on both banks.

Cabin Creek (MP 73.6), Crossing #117

(1) Crossing Geometry

- C Bank to Bank Width = 32'
- C Depth = 1 to 2'

(2) Construction Method

- C Open cut method to cross the stream and the wetlands.
- C Use the same easement as the powerline and stay as near the power poles as practical.
- C Flume the stream, install the pipe and backfill with clean local gravel and rock.

Yakima River (MP 95.9), Crossing #147

The river at this crossing is relatively slow flowing with well established and stable banks. An open cut crossing is the proposed crossing method at this site as the stream bed is primarily gravels and rock. Construction planning will include controls on bank grading, removal of all trench spoil to the banks, backfill with select gravels and rock, and tight control of runoff from the work site. Technical considerations for this method include the following:

(1) Crossing Geometry

- C Bank to Bank Width = 200'
- C Bank Height = 4'
- C Depth = 3 to 6'
- C Flows are greatly reduced after September 15.
- C West Bank rises at a moderate slope to a height of 100' plus above the river. A road parallels the river (abandoned railroad grade) 8 to 10' above the river.
- C East bank is flat for 400 to 600' and bounded to the south by an active rail line and a state highway.

(2) Construction Method

- C Open cut method during the low flow conditions but before anadramous fish migration.
- C Complete the installation with the mainline tie-ins well away from the river. Construction limits are MP 95.8 to MP 96.
- C Use south side as primary working space.
- C Bury with approximately 6' minimum cover. Trenching material can be sidecast and used as a backfill.
- C Assemble and install 300' of concrete coated pipe.

The jack-and-bore technique was not considered for this river because of the width of the river crossing and the low water table at the streamsides. Also, the compacted gravel and cobbles in the stream bed would make the chances of a successful jack and bore both expensive and doubtful. Additionally, the clean gravel bottom and the shallow depth at low flow conditions will enable a dredged crossing to be completed with few turbidity or sedimentation impacts. In addition, the horizontal directional drill does not work because of the topography of the west bank of the river.

Columbia River Near Wanapum Dam (MP 149.9)

The proposed method to cross the Columbia River is to directionally drill approximately 3,000' downstream of Wanapum Dam. The approach route is constrained to the south by the U.S. Army's Yakima Training Center (west bank) and Crab Creek National Wildlife Refuge (east bank). The pipeline comes into the crossing area following an easterly route from MP 141.8 to a flood-gravel terrace just above the river level and crosses underneath the river to a similar flood-gravel terrace north of Wanapum Village. The valley at this location is approximately 6,500 feet wide and underlain by deposits of alluvial sands and gravel with a depth to bedrock varying from 50 feet to 150 feet below the valley floor. Subsurface deposits consist of glacial soils left by water from melting glaciers and recent alluvial soils deposited by the Columbia River. Contained within the alluvium are boulders and zones of silty sands. Looking downstream, the crossing extends from an isolated floodplain area along the west bank to a broad floodplain along the east bank. Fill materials placed during the construction of the dam form a constriction along west bank at the crossing location. Typically, high flows occur at the dam due to snowmelt in the spring with specific releases of water from the dam made during the period of May through August for fisheries requirements. The Columbia River intersects the alignment at approximately ground elevation 490 feet and is approximately 1550 feet in width at the proposed crossing location. Surface vegetation consists mainly of sage and grasses. A row of deciduous trees line the east bank.

The initial assessment of this site and the construction method is presented below:

(1) Crossing Geometry

- C Bank to Bank Width = 1500'
- C Bank Height = 20'
- C Depth = 48'
- C Main channel is against the east bank.
- C Construction limits are MP 149.6 to MP 150.3

(2) Construction Method

- C Horizontal directional drill.
- C Overall drilled length is estimated as 2500' to allow adequate setback for the channel depth and the height of the banks.
- C Scour depth and drilling depth below the bottom of the river is estimated to be 24' and 50", respectively.
- C Basaltic rock is anticipated for the majority of this crossing.
- C The drillers estimated time on site is 35 days from mobilization to demobilization.
- C The difference in elevation between entry and exit points is approximately 10 feet and ample room is available within the right-of-way to establish working pads in excess of the minimum specified dimensions of 200' by 200'.
- C The setback distance on both banks exceed the recommended 100 feet for potential flooding and erosion potential.
- C Pipe support operations include pipe assembly, pretest, assistance with the pull-in of the pipe and completion of the pipeline to the construction limits.

Four other alternative locations and methods for crossing the Columbia River have been considered. From north to south, the alternative crossing locations and methods are as follows:

- C Dredging across the Columbia River north of the I-90 bridge;
- C Installing the pipeline on the I-90 bridge;
- C Installing the pipeline on the Wanapum Dam structure; and

C Installing the pipeline on the Beverly Railroad Bridge.

It is estimated that dredging across the Columbia River would have the potential for the most water quality impacts from sedimentation, and that is the least preferred alternative. The crossing location is upstream of Wanapum Dam at the northern end of Wanapum Lake. A combination of open cut and laying the pipe along the bottom of the lake is the preferred crossing method, although may not meet Department of Transportation requirements that the pipeline be buried across the entire crossing. The wet open cut will extend approximately 60 feet into the lake from the east and west banks, respectively with an approximate 5 foot depth of cover adjacent to the shoreline. The depth of cover will be tapered to the location at which the pipe will be placed at the bottom of the river. The west bank approach is relatively flat with sufficient working area. The eastern approach is at the waterline of an abandon road to the river. A ground penetrating radar survey indicated that the western approach is underlain by a deep gravel deposit with the bedrock dipping away from the shoreline. Shallow gravel deposits were interpreted to exist at the eastern approach with the bedrock near the ground surface and dipping away from the shoreline. Specific details are listed below.

(1) Crossing Geometry

$ Bank to Bank Width = 4350'
$ Depth = 105'
$ Main channel is along east bank

(2) Construction Method

$ Partial wet open cut
$ Estimated length of cuts 120 feet
$ Wall thickness of the pipe will be increased 0.5 inches and a concrete coating of at least 1 inch will be added to the outside of the pipe.

OPL has initiated discussions with the Washington State Department of Transportation (WSDOT) concerning installing the pipeline on the I-90 bridge. As of the date of this application, WSDOT has not either approved or denied the request.

A permit application has been made to the Grant County PUD, operators of the Wanapum Dam, for permission to install the pipeline near the top of the spillway. As of the date of preparation of this document, Grant County PUD has neither approved or denied the request.

Preliminary geotechnical information has indicated that the Beverly railroad bridge would be usable for a pipeline crossing. A permit application has been made to Washington Department of Natural Resources (DNR). As of the date of preparation of this document, DNR has neither approved or denied the request.

TABLE 2.14-1
SUMMARY OF MAJOR RIVERS AND UNIQUE CROSSING CONSTRUCTION METHODS

Stream Name	Crossing Geometry			Crossing Method
	Bank to Bank Width	Bank Height	Depth	
Snoqualmie River Crossing #1	200'	15'	6 to 8'	Preferred: Bridge Alternative: Horizontal directional drill
Peoples Creek Crossing #1 Crossing #2	 10' 10'	 15' 10'	 1' 1'	 Over Culvert Flume
Griffin Creek	10'	1-2'	1'	Divert
Tolt River	40' main channel 30' secondary channel	6' (riprap along north bank)	1 to 2'	Divert
Tokul Creek	30'	20'	2 to 3'	Bridge
Snoqualmie River Crossing #2	120'	10 to 20'	8 to 10'	Bridge Crossing
South Fork Snoqualmie River (Crossing 1)	500' main channel	15 to 20'	4 to 5'	Bridge crossing
South Fork Snoqualmie River (Crossing 2)	120' 300' secondary channel	60'	3 to 4'	Bridge crossing
West Slope of Snoqualmie Pass - several creeks: Boxley Creek Change Creek Hall Creek Mine Creek Rock Creek Harris Creek Carter Creek Hansen Creek	10 to 50'	2 to 12'	dry to 2' with large boulders	Flume or Divert Bridge Wet Trench Wet Trench Divert Divert Flume or Divert Flume or Divert
Humpback Creek	25'	3'	2 to 3', fast flowing with large boulders	Wet Trench
Roaring Creek	60 to 80'	20'	20 to 30'	Divert
Meadow Creek	120'	15'	2 to 3'	Divert
Cabin Creek	20'	1 to 2'	1 to 2' adjacent to wetland	Divert
Yakima River	200'	4'	3 to 6'	Divert
Columbia River Proposed method: Below Wanapum Dam Four alternative locations: (1) I-90 bridge (2) Wanapum Dam (3) Beverly railroad bridge (4) Upstream of I-90 Bridge	 2,100' 4,350'	 40 to 45' shallow bank	 15 to 25' 105'	 Horizontal Dir. Drill Four Alternatives: (1) cross on I-90 Bridge (2) cross on Wanapum Dam (3) cross on Beverly railroad bridge (4) Wet Trench Upstream of I-90 Bridge

2.14.4 IRRIGATION CANAL CROSSINGS

Three methods will be used for crossing irrigation canals. In general unlined irrigation canals will be crossed by open cut methods as described above and concrete canals will be crossed using boring and jacking techniques. Unfavorable conditions at concrete canal crossings may require spanning the canal. The boring and jacking method requires a starting and ending pit. The first step after ROW clearing is to dig a bore pit on one side and a receiver pit on the other. These have to be about two feet deeper than the depth of the pipe. The bore pit will be about 10 to 15 feet wide at the bottom of the pit, and possibly wider at the top of the pit depending on soil and slope condition, and 50 feet long. The receiver pit will not need to be larger than 10 X 10 feet at the bottom of the pit. The next step is to lower the boring equipment into the launch pit along with the first joint of pipe. The boring machine augers a hole and at the same time pushes the pipe through it, one length at a time. The pipe lengths will have the corrosion coating and a one-inch thick concrete jacket already in place before being installed. Most canals will be bored using conventional auger boring or guided boring techniques unless subsurface conditions are unfavorable (i.e., rock, gravel, glacial till, or high water tables with flowing sands).

2.14.5 WETLAND CROSSINGS

Wetlands are present along the entire route (see Section 3.4 Plants and Animals) and are crossed by the pipeline in approximately 78 locations, temporarily disturbing approximately 17 acres. Wetland identification and delineations were conducted as a part of the environmental evaluation of the proposed pipeline route. Route selection was directed toward avoiding wetland areas to the extent possible. The final alignment will further avoid wetland areas wherever possible.

Where wetland areas are crossed as a part of pipeline construction, special construction techniques will be used to minimize impacts. See Figure 2.14-6 for the typical wetland crossing configuration, but several of the methods described for stream crossings in special circumstances will apply to wetlands as well (for example, some wetlands are crossed on existing roads). These wetland construction methods will include the following special procedures:

Figure 2.14-6 Typical Wetland Crossing Excavation and Fill

Access, Staging, and Ancillary Areas

- The only access roads, other than the construction right of way, which will be used in wetlands are those existing roads that can be used with little or no modification and no impact on the wetland.
- All construction equipment will be refueled at least 100' from water bodies or wetland boundaries.
- All equipment will be cleaned and inspected prior to entering a wetland. Equipment leaking oil or other fluids will not be allowed to enter a wetland.

Spoil Pile Placement and Control

- The upper 6 to 12" of topsoil will be removed and protected throughout construction. This material may be stockpiled in adjacent upland areas.
- All spoil material from water body crossings must be placed in the right of way at least 10' away from the ordinary high water line. At a minimum, all spoil shall be contained within sediment filter devices.
- The materials removed from the trench below the topsoil level may also be stockpiled in adjacent upland areas. However, it will not be placed on top of, or mixed with, the topsoil material previously removed.

General Construction Procedures

- All activities within the wetland will be kept to the minimum disturbance area possible.
- In wetlands and riparian areas, vegetation that must be removed will be cut at ground level, leaving existing root systems intact. The pulling of tree stumps and grading activities will be limited to those that would directly interfere with trenching, pipe installation and backfill.
- As shown on Figure 2.14-7, trench plugs will be used as necessary to prevent diversion of water into upland portions of the pipeline trench. In addition, a trench bottom sealing material, or construction techniques such as a combination of compaction materials, will be used in certain wetland areas to avoid draining a perched wetland.

Figure 2.14-7 Typical Trench Plugs

- Grading will not take place within the boundaries of any wetland, and disturbance will be kept to the minimum necessary to safely construct the pipeline.
- Pipe sufficient to cross the wetland will be welded on the right-of-way and inspected by radiography before being carried or pulled into the wetland and lowered into the trench. In long wetland stretches, it may be more feasible to weld up several joints of pipe, carry them into the trench leaving one end at the welding location, weld on additional lengths, pull them into the trench, and repeat this process until the entire wetland length has been crossed.
- If standing water or saturated soils are present, low ground weight construction equipment will be used, or construction will be done using prefabricated equipment mats.
- In the event that matting is necessary, all construction activities will be carried out from the matting. Equipment will not be allowed in the wetland off the mats, at any time. The mats will be inspected prior to placing in the wetland and mats with foreign material will not be used.
- Once the pipe has been laid in the trench, the subsoil will be replaced, followed by the topsoil. Excess material will be spread on the right-of-way outside the wetland boundaries. (Figure 2.14-8 Typical Wetland Crossing Open Trench Method).

Figure 2.14-8 Typical Wetland Crossing Open Trench Method

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